



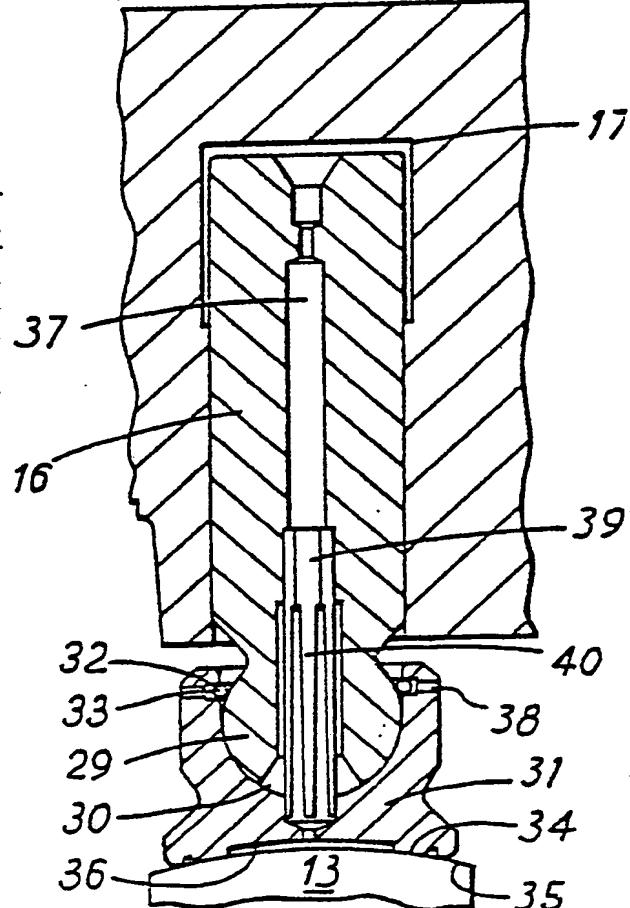
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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## (54) Title: RADIAL PISTON PUMPS

## (57) Abstract

In a unit having a booster pump connected in the supply to the cylinders (17) so that the piston (16) is held in engagement with the driving eccentric (13) by the supply pressure, without the use of springs, a slipper (31) with a hydrostatic pad (36) engages the eccentric (13) and has a socket (30) which receives a ball (29) on the end of the piston. The ball (29) is held in place by spring ring (32). To minimize misalignment of the slipper (31) with the eccentric (13) when the pump is not running, a centering spring (39) with fingers (40) is arranged in the bore (37) supplying the pad (36). To avoid shocks and damage resulting from misalignment mating surfaces (34 and 35) are spherical rather than cylindrical.



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RADIAL PISTON PUMPS

The present invention relates to radial piston pumps.

Existing radial piston pumps often require a header tank on the supply side to fill the cylinders of the pump. They use springs to hold the pistons in engagement with the eccentric drive member and when these are positioned within the cylinder, this results in substantial un-swept volume and consequent low efficiency. It is now proposed to use a booster pump on the supply side, as has been done with axial piston pumps, and to use the pressure thus generated to hold the pistons in engagement with the eccentric. This is satisfactory when the pump is running but gives rise to problems on start-up because the piston may be out of contact with the eccentric, resulting in shocks and damage when they are re-engaged.

In accordance with the present invention there is provided a radial piston pump comprising at least one bank of pistons each arranged to be held in engagement with an eccentric drive member principally by means of the input pressure generated by a booster pump, wherein each piston engages the eccentric member by way of a slipper which is mounted on the end of the piston by means of a pivot joint, a centering spring extends between each piston and its slipper to provide a restoring force against pivoting of the slipper about the said joint, and the slipper has a part-spherical surface mating with a part-spherical surface of the eccentric.

With such a construction separation of the slipper from the eccentric is not a problem because the centering spring prevents more than a few degrees droop of the slipper under its own weight even when the piston is horizontal. The mating part-spherical surfaces avoid difficulties which could arise from misalignment of cylindrical surfaces due to rotation of the slipper about the axis of the piston either independently or together with the piston.

Preferably the pivot joint is a ball and socket joint with the ball held in position by a resilient ring in an oversize groove so that the joint can be assembled and disassembled by snap action. The ball is preferably formed on the end of the piston and the socket in the slipper.

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The slipper is preferably provided with a hydrostatic bearing pad for engagement with the eccentric and this pad can be supplied with liquid from the cylinder by way of a bore extending axially through the piston. The centering spring can be accommodated in this bore and have resilient tongues extending into a recess in the slipper.

5 The invention will now be described in more detail with the aid of an example illustrated in the accompanying drawings, in which:-

10 Fig. 1 is a longitudinal section of a radial piston pump in accordance with the invention,

Fig. 2 is a plan view with part cut away to show the valves for one of the cylinders, and

15 Fig. 3 is a detail on an enlarged scale of one of the cylinders of the pump.

The pump shown in the drawings has a shaft 10 mounted in bearings 11 and 12 and formed with three eccentric drive members 13, 14 and 15. Each of the eccentrics drives a bank of four pistons 16 which are arranged at equal angular spacing around the shaft. Each piston 16 operates in a cylinder 17. The shaft 10 also drives a boost pump 18 of the "Gerotor" type which comprises a lobed disc or gear 19 rotating in an eccentric housing 20 whose inner surface has complementary lobes and pumping between arcuate inlet and outlet slots 21 and 22. The inlet slot 21 is connected 20 with a supply tank and the boost pump 18 feeds liquid by way of a duct 23, an annulus 24 and four supply ducts 25 to the cylinders 17. A relief valve 26 controls the supply pressure from the boost pump 18 to the cylinders 17.

25 As seen in Fig. 2, the inlet to each cylinder 17 is controlled by a suction valve 27 while the outlet is controlled by a discharge valve 28. These valves are arranged on opposite sides of the cylinder and close to the cylinder head. The piston 16, as will be seen, does not require biasing springs and thus at the top of its stroke can come close to the cylinder head to minimize the un-swept 30 volume of liquid in the cylinder.

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Referring now to Fig. 3 it will be seen that each of the pistons 16 at its inner end has the form of a ball 29 which is received in a socket 30 of a slipper 31, through which the eccentric (here eccentric 13) drives the piston. The ball 29 is held in the  
5 socket 30 by a spring ring 32 disposed in an oversize groove 33 which allows the ring 32 to expand when the ball is pressed into or pulled out of the socket. The slipper 31 has a part spherical surface 34 engaging the correspondingly curved surface 35 of the eccentric 13. A recess 36 in the surface 34 is supplied with  
10 liquid from the cylinder 17 by way of an axial bore 37 in the piston 16 in order to form a hydrostatic pad bearing. Liquid passing through the bore 37 also lubricates the mating surfaces of the ball 29 and socket 30 and any excess pressure can be relieved through bores 38 communicating with the groove 33.

15        Mounted in the bore 37 of each piston is a finger spring 39, whose fingers 40 engage a recess in the back of the slipper 31 to hold the slipper axially aligned with the piston. Thus, even when the pump is stationary and the slipper 31 may separate from the eccentric 11 because there is no supply pressure to hold them in  
20 contact, the weight of the slipper is counteracted by the spring 39 and only small angular displacements of the slipper about the ball 29 are possible. In this example the spring 39 is formed of a strip of spring steel formed with the required fingers 40 and bent round into a tube which fits into a socket in the bore 37.

25        The interior of the pump casing is filled with the liquid, usually an oil, being pumped which provides lubrication for the bearings 11 and 12 and for the eccentrics 13, 14 and 15. This liquid enters the casing through a duct 41 from the pressure relief valve 26 and passes through the bearings 11 and 12 before returning by way  
30 of an axial bore 42 in the shaft 10 and a check valve 43 to the inlet groove 21 of the boost pump 18.

The boost pump 18 is so designed and so connected with the inlets and outlets of the main pump cylinders that it will only boost the supply pressure when the shaft 10 is rotated in the correct sense.  
35        However the sense of rotation can be reversed if an end plate 44,

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which determines the eccentricity of the housing 20 of the boost pump 18, is turned through 180° about the axis of the shaft.

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CLAIMS :-

1. A radial piston pump comprising at least one bank of pistons (16) each arranged to be held in engagement with an eccentric drive member (13) principally by means of the input pressure generated by a booster pump (18), wherein each piston engages the eccentric member by way of a slipper (31) which is mounted on the end of the piston by means of a pivot joint (29, 30), a centering spring (40) extends between each piston and its slipper to provide a restoring force against pivoting of the slipper about the said joint, and the slipper has a part-spherical surface (34) mating with a part-spherical surface (35) of the eccentric.

2. A pump as claimed in claim 1 in which the pivot joint is a ball and socket joint with the ball (29) held in position by a spring ring (32) arranged to allow assembly and disassembly by snap action.

3. A pump as claimed in claim 2 in which the ball (29) is formed on the end of the piston (16) and the socket (30) in the slipper (31).

4. A pump as claimed in any of claims 1 to 3 in which the slipper (31) has a hydrostatic bearing pad (36).

5. A pump as claimed in claim 4 in which a supply bore (37) extends axially through the piston (16) to feed the pad (36) from the cylinder (17).

6. A pump as claimed in claim 5 in which the centering spring (39) is accommodated in the supply bore (37).

7. A pump as claimed in claim 6 in which the centering spring has resilient tongues (40) extending into a recess in the slipper.

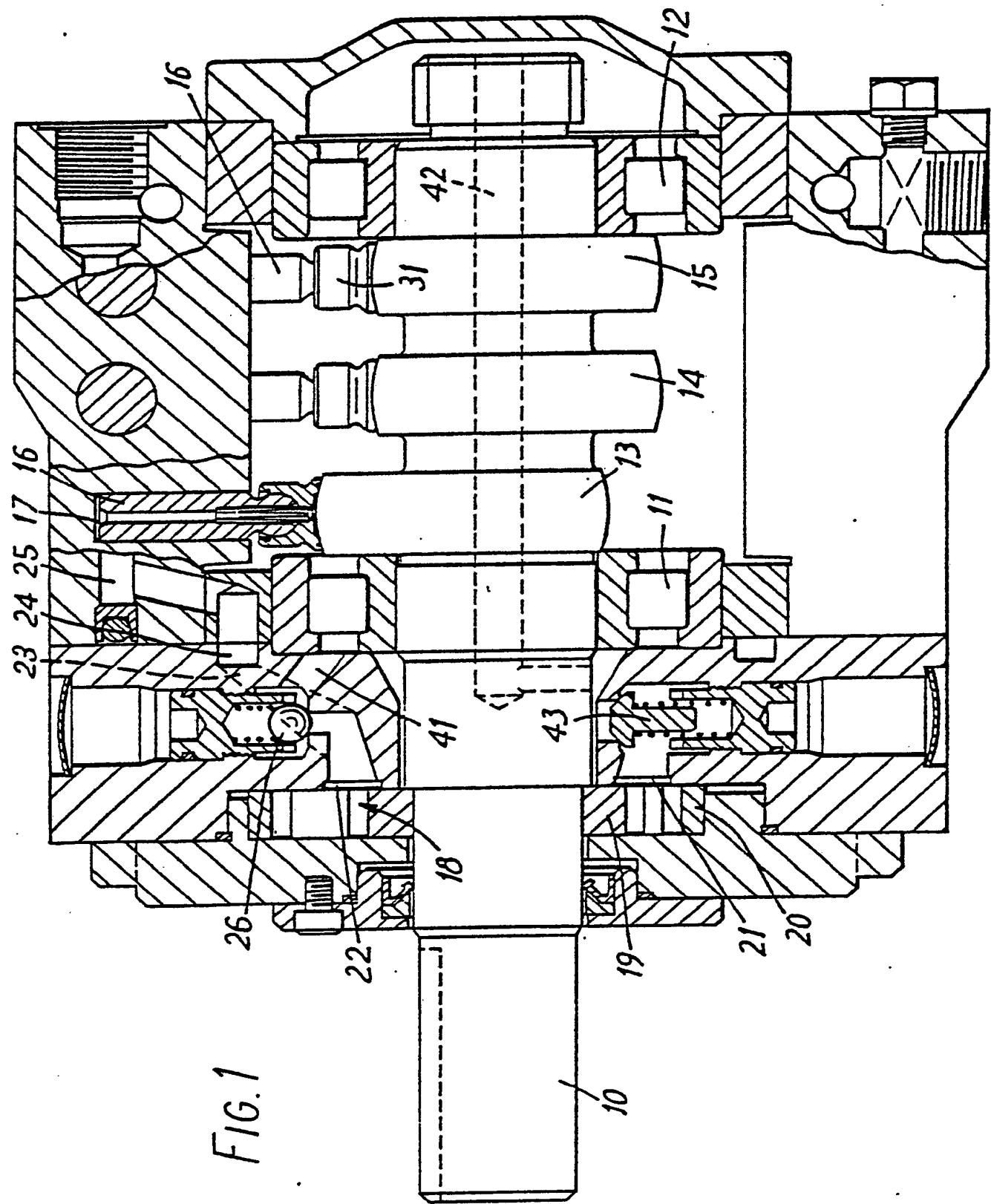


Fig. 1

B.C.R.I.

FIG.2

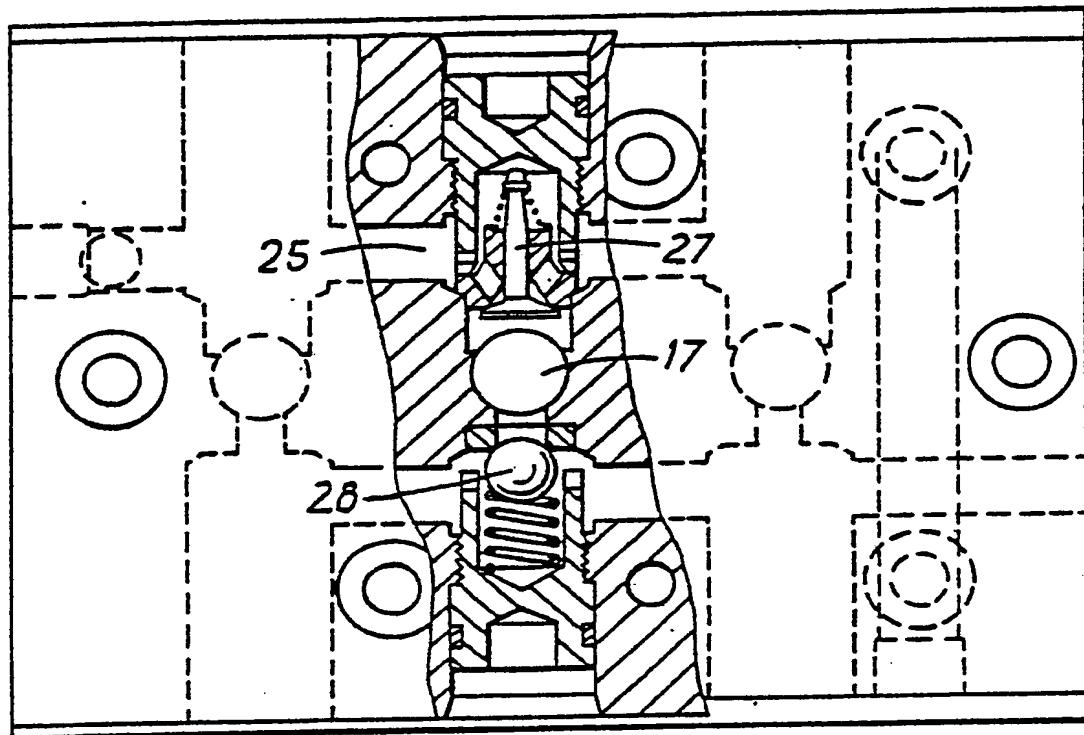
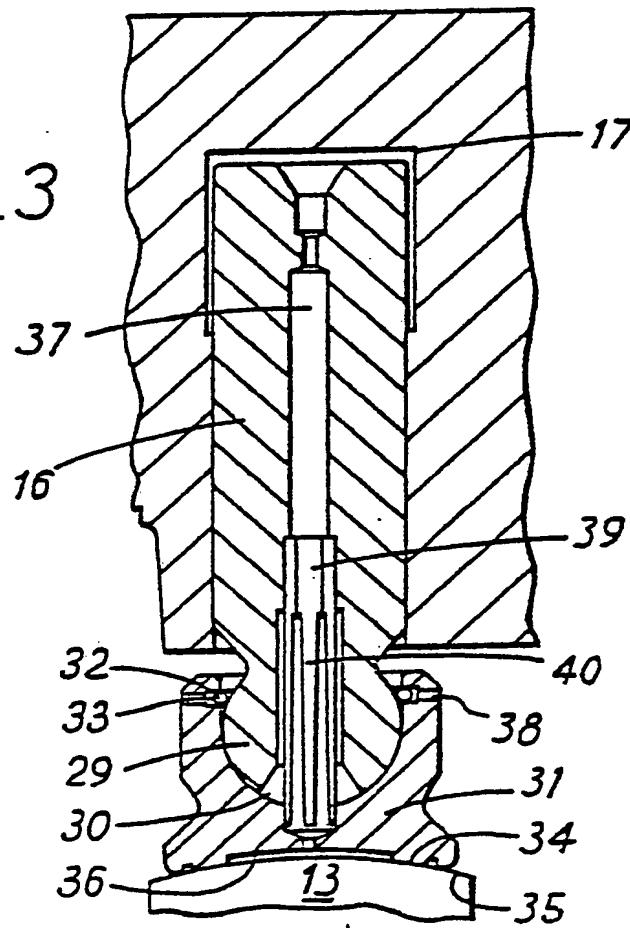


FIG.3



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## I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all):

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl.<sup>3</sup>: F 04 B 1/04

## II. FIELDS SEARCHED

Minimum Documentation Searched<sup>4</sup>

Classification System	Classification Symbols
Int.Cl. <sup>3</sup> :	F 01 B; F 04 B

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched<sup>4</sup>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>14</sup>

Category <sup>5</sup>	Citation of Document, <sup>15</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>18</sup>
	GB, A, 1436752, published May 26, 1976 see page 2, lines 53-121, Eickmann --	1,3,4,5
	US, A, 2851952, published September 16, 1958 see column 2, lines 10-37, Lane --	1
	US, A, 2293693, published August 18, 1942 see page 2, lines 32-50, Wylie --	1
	US, A, 2302864, published November 24, 1942 see page 2, lines 10-26, Huber --	1
	FR, A, 2296778, published July 30, 1976 see page 6, lines 19-21, Courtois --	1
	GB, A, 928587, published June 12, 1963 see page 2, lines 65-93, Council for Scientific and Ind. Research --	2
	US, A, 4018137, published April 19, 1977 see column 2, lines 53-59, Bosch --	2
A	DE, A, 2118712, published November 16, 1972 see figures 1a, 1b, Bosch -----	

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## IV. CERTIFICATION

Date of the Actual Completion of the International Search<sup>22</sup>

5th November 1981

Date of Mailing of this International Search Report<sup>23</sup>

17th November 1981

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